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INTEROFFICE MEMORANDUM

November 18, 1969

Mr. R. R. Leveille, Mgr. of Concentrating
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Subject: Research into Stabilization of Tailings with Vegetation at Utah Copper Division

The following memorandum contains a brief chronological summary of recent research into the use of plants for stabilization of Utah Copper Division tailings, and recommendations for additional research.

## HISTORY

The present program investigating the use of plants to stabilize UCD tailings started in 1964 as an adjunct to the proposed Great Salt Lake Authority - Kennecott test project to use tailings material as fill on the Great Salt Lake. Progress on this research has been as follows:

### 1964

Plans were developed by the Great Salt Lake Authority and UCD to establish a vegetation test plot in connection with the tailings test program in order to evaluate the value of plants for beautifying and stabilizing fills constructed of tailings. Arrangements were made for Utah State University to handle this aspect of the overall tailings test. A small quantity of UCD tailings were furnished to USU for preliminary greenhouse tests and these tests started in the fall.

### 1965

Greenhouse tests continued at USU through the winter. This program indicated good seed germination in tailings, but that toxic reactions develop in the plants as they mature. Also, the need for nitrogen to sustain plant growth became apparent. In the spring, the greenhouse tests were supplemented with a field test consisting of fifty 10-gallon drums filled with tailings, treated with various amendments and planted with tall wheat grass, crested wheat grass, Russian wild rye, and yellow clover. These field tests did not have the initial success of the greenhouse test, and in most of the drums, the plants showed signs of toxicity ranging from stunting of growth to death of the plants.

Results of these preliminary tests indicated that there were fundamental problems to plant growth in tailings that had not been recognized in earlier vegetation tests. Consequently a tentative program for research into the physical and chemical nature of tailings and their effects on plant growth, and into selection of plants amenable to growth in tailings, to be performed by USU and financed by KCC, was developed, but did not receive approval by KCC.

1966

In January of 1966 the U. S. Bureau of Mines, Salt Lake City Research Center was authorized to investigate techniques for utilizing and beautifying tailings. At the suggestion of KCC, the Bureau of Mines arranged with USU to finance a 3-year research project, based on, but expanded from, the proposed KCC-USU research project. This project involved: (1) a search of the literature related to plant growth in tailings and preparation of a bibliography; (2) physical and chemical investigations into the nature of various tailings; (3) greenhouse tests on plant growth in tailings; and (4) field tests of plant growth in tailings. Kennecott maintained contact with both USBM and USU as the research program was being formulated, and because of the cooperation by KCC it was decided to use UCD tailings as the standard material for the majority of the USU studies. The USU - USBM project was initiated in fiscal year 1967, starting on July 1, 1966.

During the summer of 1966, USU maintained the field test of plant growth in 10-gallon drums. The perennials that survived the first year in these drums appeared to do better during the second year.

By the end of the year it had become apparent that salinity and heavy metals were the major problems to plant growth in UCD tailings. It is likely that much of the salinity comes from the brackish water used in the mill circuit.

1967

Laboratory studies were continued by USU during 1967. Some of the results from these studies include determination of some of the plants more likely to grow successfully in tailings, and evidence that legumes will form nodules of a type characteristic of nitrogen fixation when growing in tailings.

In connection with the large scale field tests proposed by USU, UCD had agreed to prepare a test site of approximately 2 acres near the southwest corner of the tailings pond. This test site was divided into four sections with various methods of preparation. Construction of dikes and related facilities around the site had been completed and plans were underway for placement of the tailings when the work was halted by the copper industry strike. Because there was no field site available, this portion of the USU program was delayed.

1968

The UCD field test plots were not completed until the early fall of 1968. Only one plot, composed of the coarse fraction of cycloned tailings, dried sufficiently to be prepared and 50% was planted with tall wheat grass, intermediate wheat grass and rye. The other 50% was reserved for spring planting in 1969.

1969

The material planted on the UCD test plot in the fall of 1968 wintered well, although pheasants ate a significant amount of the rye seeds during the winter, but despite this set-back, germination was relatively good. This vegetation could not be irrigated when originally planned because of a pipeline freeze-up during the winter which supplied the irrigation water, and this lack of water was a slight set-back to the plants. The spring season turned out to be poor for plant growth with dry, windy conditions. Although the tall wheat grass grew relatively well, and developed a stabilized cover, the intermediate wheat grass did not do well. The rye was intermediate with moderate success.

The other half of the first test plot was planted in the spring to barley, intermediate wheat grass, tall wheat grass, sweet clover and alfalfa. These seeds had good germination, but the windy, dry spring and problems with obtaining personnel to run the irrigation season were a detriment to plant growth. During the summer the tall wheat grass developed a relatively good stand. The intermediate wheat grass did poorly. Some of the legumes grew moderately well but not as well as was desired, and the barley went through its entire life cycle. Some of the intermediate wheat grass area was overplanted with sorghum as an experiment, but this was not very successful. At the present time the tall wheat grass is relatively well established. There is some established intermediate wheat grass and legumes. Also, there had been a volunteer invasion of the area with tamarisk.

No other test plots were planted in the spring of 1969 because of inadequate irrigation water for more than the one test plot. In the fall USU personnel planted a second plot with tall and crested wheat grass in order to utilize winter moisture. The USBM has terminated its support of USU research as of July 1, 1969 and the remaining work for 1969 is being done with carryover USBM funds and USU funds.

## FUTURE PLANS

USU would like to continue the field program at the UCD tailings ponds if funds can be made available. The initial program would involve continuation of the plant growth in the first plot using limited irrigation and a minimum of maintenance in order to determine the hardiness of the established plants. On the second plot, the plans call for irrigation and possibly overseeding of the area with legumes and treatment with mulches to control wind erosion. In addition, future plans call for experimentation on the other ponds using varied amendments and varied levels of care and irrigation.

Personnel at USU estimate that with three years of additional work on the test plots, definitive information on the potentiality of stabilizing the UCD tailings pond with vegetation should be available. This information would be anticipated to include requirements for site preparation, types of plants best suited to growth, necessary amendments to the tailings to support growth, necessary care for planted areas, and anticipated longevity of plants growing on tailings.

If Kennecott is interested in a 3-year program at the tailings pond, USU would be willing to supply the services of a supervisory agronomist for the project. Additional annual expenses for the research would be anticipated to be approximately as follows:

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| Technician (estimated 2/3 man-year) | $ 6,300 |
| Laboratory Analysis | 1,500 |
| Supplies | 600 |
| Irrigation | 1,000 |
| Travel | 600 |
| USU Overhead | 3,000 - 5,000 |
| Total | $13,000 - $15,000 |

We believe that the proposed research is an important adjunct to the work already performed by USU under the sponsorship of USBM. A significant amount of the work could have been performed already if preparation of the field test site had not been delayed for approximately a year by the copper strike. When the time comes that UCD abandons the present tailings pond, some method of stabilization will be essential, and at present, vegetation appears to be the best permanent solution. Consequently, we consider it essential to continue the ongoing research to its completion, either favorable or unfavorable.

The major benefit of the present research will be to Utah Copper Division, but some of the principles and concepts developed from it will be of value to other MMD properties. Consequently, we propose that the research be supported jointly by UCD and MMD-ED with each party contributing $6,500 - $7,500 per year. MMD-ED has budgeted funds for tailings stabilization research through 1973, part of which are allocated for projects of this nature.

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